

Claims

1. 424/426

1. An implantable bone paste composition comprising gelatin as a carrier
2 for substantially bioabsorbable osteogenic components for use in a recipient in need
3 thereof.

1 2. The bone paste of claim 1 for use in the repair of non-union fractures,
2 periodontal ridge augmentation, craniofacial surgery, arthrodesis of spinal or other
3 joints, spinal fusion procedures, and implant fixation.

1 3. The composition of claim 1 wherein the gelatin is thermally cross-
2 linkable at or slightly above the temperature of the organism into which it is to be
3 implanted.

1 4. The composition of claim 3 wherein said composition gels at about
2 38°C.

1 5. The composition of claim 3 wherein said gelatin is present at a
2 concentration of between about 20-45% (w/w) gelatin as a fraction of the weight of
3 the composition.

1 6. The composition of claim 5 wherein the osteogenic component is
2 selected from the group consisting of:

- 3 (i) demineralized bone matrix (DBM);
4 (ii) bioactive glass ceramic, BIOGLASS®, bioactive ceramic, calcium
5 phosphate ceramic, hydroxyapatite, hydroxyapatite carbonate, coralline
6 hydroxyapatite, calcined bone, tricalcium phosphate, or mixtures
7 thereof;

- 8 (iii) bone morphogenetic protein, TGF-beta, PDGF, or mixtures thereof,
9 natural or recombinant; and
10 (iv) mixtures of (i)-(iii).

1 7. The composition of claim 6 wherein the gelatin, the demineralized bone
2 matrix, or both are derived from the species into which the bone paste is to be
3 implanted.

1 8. The composition of claim 7 wherein DBM is present at between about
2 0-40% (w/w) of the total ^{composition} composite weight.

1 9. The composition of claim 8 wherein DBM is present at between about
2 15-33% (w/w) of the total ^{composition} composite weight.

1 10. The composition of claim 6 wherein the bioactive glass is BIOGLASS®.

1 11. The composition of claim 6 wherein component (ii) is present at
2 between about 0-40% (w/w) of the total composition mass.

1 12. The composition of claim 6 comprising antibiotics, bone morphogenetic ^{proteins}
2 ~~or other proteins~~, whether derived from natural or recombinant sources, wetting
3 agents, glycerol, carboxymethyl cellulose (CMC), growth factors, steroids, non-
4 steroidal anti-inflammatory compounds, or combinations thereof.

1 13. The composition of claim 6 comprising between about 0.0001 to 0.1
2 mg/ml bone morphogenetic protein.

1 14. The composition of claim 1 which is a frozen solution or is freeze-
2 dried.

1 15. The composition of claim 1 wherein the gelatin is human, bovine,
2 ovine, equine, canine or mixtures thereof.

1 16. The composition of claim 1 wherein the gelatin is derived from human
2 collagen sources via enzymatic, acid or alkaline extraction.

1 17. The composition of claim 16 wherein said human collagen sources are
2 human skin, bone, cartilage, tendon, connective tissue, or mixtures thereof.

1 18. The composition of claim 17 produced by treating the collagen source
2 with pepsin at about 33°C, heat denaturing the thus treated collagen under controlled
3 conditions to produce gelatin, and mixing the thus produced gelatin with an
4 osteogenic compound such that the gelatin is present at a final concentration of
5 about 20-45% (w/w).

1 19. The composition of claim 18 wherein the denaturation is achieved by
2 heating to at least 50°C.

1 20. The composition of claim 19 wherein the gelatin has a molecular weight
2 of greater than about 50,000 daltons.

1 21. The composition of claim 1 wherein the osteogenic component is
2 demineralized bone matrix in a powdered form, and is composed of particles in the
3 size range between about 80-850 μm in diameter.

1 22. The composition of claim 21 comprising about 0-40% (w/w) demineralized
2 bone matrix powder, provided that if the demineralized bone matrix powder is
3 absent, then a bone growth factor is present at a concentration of at least 0.0001
4 mg/ml.

1 23. The composition of claim 22 wherein said bone growth factor is
2 morphogenetic protein, TGF- β , PDGF, or mixtures thereof, natural or recombinant.

Sub A3
1 24. The composition of claim 6 wherein the bioactive glass is BIOGLASS®
2 having a diameter of between about 0.5-710 μ m.

1 25. The composition of claim 1 further comprising cortical, cancellous or
2 cortical and cancellous bone chips.

1 26. The composition of claim 25 wherein said bone chips are in the size range
2 of 80 μ m to 10 mm.

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1 Super 27. The composition of claim 1 which is injection molded, vacuum molded,
2 rotation molded, blow molded, extruded or otherwise formed into a solid form.

1 28. The composition of claim 27 wherein said form is selected from vertebral
2 disks, acetabular hemispheres, tubes, ellipsoid, oblong, and "U" shapes for void filling,
3 intramedullary plug formation, and impaction grafting.

Sub P2
1 29. A method for inducing bone formation *in vivo* in a recipient in need
2 thereof which comprises implanting an effective amount of an implantable bone paste
3 composition comprising gelatin as a carrier for substantially bioabsorbable osteogenic
4 components.

1 30. The method claim 29 which comprises repairing non-union fractures,
2 achieving periodontal ridge augmentation, conducting craniofacial surgery, securing
3 implants, arthrodesis of spinal or other joints, spinal fusion procedures, or impaction

4 grafting, which comprises implanting said composition at the site *in vivo* in need of
5 such treatment.

1 31. The method according to claim 30 which comprises formation of a series
2 of small apertures in an intervertebral space and injection of said composition into
3 said space to induce artherodesis.

1 32. The method according to claim 30 which comprises extruding said
2 composition from a syringe at a temperature at a first temperature at which it
3 remains liquid or highly maleable, and forming a resilient, sticky and easily formable
4 shape from said composition as it gels at a second temperature at or slightly above
5 the body temperature of the organism into which it is implanted.

1 ✓ 33. A method for making an implantable graft which comprises preparing a
2 composition comprising a thermally cross-linkable gelatin carrier and suspending
3 therein a substantially bioabsorbable osteogenic component.

1 34. The method of claim 33 wherein said osteogenic component is selected
2 from:

- 3 (i) demineralized bone matrix (DBM);
4 (ii) bioactive glass ceramic, BIOGLASS®, bioactive ceramic, calcium phosphate
5 ceramic, hydroxyapatite, hydroxyapatite carbonate, corraline hydroxyapatite,
6 calcined bone, tricalcium phosphate, or like material;
7 (iii) bone morphogenetic protein, TGF- β , PDGF, or mixtures thereof, natural or
8 recombinant; and
9 (iv) mixtures of (i)-(iii).

1 35. The method of claim 34 which further comprises injection molding,
2 vacuum molding, rotation molding, blow molding, extruding ~~or otherwise forming~~

3 said composition into the desired form of a solid graft, and allowing the composition
4 to solidify at a temperature at which the gelatin becomes thermally cross-linked.

1 36. The method of claim 35 wherein said form is selected from vertebral
2 34 disks, acetabular hemispheres, tubes, ellipsoid, oblong, and "U" shapes for void filling,
3 intramedullary plug formation, and impaction grafting.

1 37. The method of claim 36 which comprises raising the temperature of the
2 37 composition above its liquefaction temperature and allowing the composition to gel
3 in a mold of appropriate shape.

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